In order to further improve the S/N ratio, a magnetic shield plate formed of a magnetic metal material may be interposed between the motor stator magnetic pole and the detection coil magnetic pole of the variable-reluctance resolver. This has an effect that magnetic noises generated by the motor magnetic field are bypassed by the magnetic substance superior in magnetic properties disposed between the motor and the resolver, so that the magnetic flux does not act on the resolver stator detection coil.

In this case, as the magnetic substance superior in the magnetic properties, an electromagnetic steel plate, permalloy and the like may be used.

As described above in detail, the invention relates to a sealed actuator in which a sealing partition wall made of a nonmagnetic metal material is provided between a stator magnetic pole of a motor stator and a rotor magnetic pole of a motor rotor, and a space where the motor rotor is disposed is hermetically isolated from a space where the motor stator is disposed.

According to the first aspect of the invention, the bearings of the sealed actuator for supporting the motor rotor are a plurality of rolling bearings, and the rolling bearings support the motor rotor at positions on the housings at both sides of a member constituting the sealing partition wall in a longitudinal direction of the motor rotor so that the housings directly receive a load applied to the bearings. According to this, even if an arm or the like is attached to the motor rotor and force such as bending moment caused in the motor rotor is applied to the bearings, the force does not act on the hermetically sealing partition wall, so that such a superior effect as eliminates the fear that the sealing partition wall is broken, can be obtained.

According to the second aspect of the invention, the sealed actuator adopts a variable-reluctance resolver for detecting the position of the motor rotor with respect to the motor stator. The resolver comprises a resolver rotor made of a magnetic metal material and including salient pole teeth at a side of the motor rotor; and a resolver stator including a detection coil magnetic pole at a side of the motor stator. According to this, there is obtained such a superior effect that even if the partition wall made of nonmagnetic material is interposed between both, the position of the motor rotor can be accurately detected. Since such a resolver rotor that magnetic salient poles (slot teeth) are provided on the magnetic metal material is adopted to decrease the surface area, it is made suitable for use in vacuum environment.

According to the third aspect of the invention, since at least a part of the partition wall disposed between the stator magnetic pole of the motor stator and the rotor magnetic pole of the motor rotor of the sealed actuator is reinforced by reinforcing means, even if the actuator is used in an ultra-high vacuum apparatus, there occurs no such a disadvantage that the partition wall exposed to vacuum is expanded to be deformed. Further, there is obtained such a superior effect that deformation of the sealing partition wall at thinning working of the partition wall from the inner diameter side of the motor rotor can be prevented to perform accurate thinning working.

As the reinforcing means, there are adopted such means as the use of reinforcing members, filling of a mold agent.

According to the fourth aspect of the invention, the sealed actuator is used as a unit sealed actuator, a plurality of unit sealed actuators are connected in series to each other, and a plurality of output shafts of the motor rotors are coaxially arranged. According to this, the following effects can be obtained. That is, it is possible to easily construct the sealed actuator having a plurality of coaxial shafts.

Further, when the actuator is mounted to a vacuum vessel or the like, the plurality of shafts can be inserted into the inside of the vacuum vessel or the like through one common opening, so that the number of connection portions between the actuator and the vacuum vessel or the like can be decreased.

Further, in the invention, since a variable-reluctance resolver is provided as displacement detection means, there is obtained such an effect that it is possible to prevent the magnetism from the motor stack from surrounding so that stable and high accuracy positioning control can be made.

What is claimed is:

1. A sealed actuator comprising:

a motor stator including a stator magnetic pole excited by a rotation-drive coil;

housings to which said motor stator is attached;

a motor rotor including a rotor magnetic pole disposed opposite to a surface of said stator magnetic pole through a gap;

bearings for rotatably supporting a rotation shaft of said motor rotor to said housing;

displacement measuring means for measuring displacement of said motor rotor; and

a hermetically sealing partition wall made of a nonmagnetic metal material and disposed at the gap between said stator magnetic pole and said rotor magnetic pole, a space where said motor rotor is disposed being hermetically isolated from a space wherein said motor stator is disposed;

wherein said bearings are a plurality of rolling bearings, said rolling bearings supporting said motor rotor at positions on said housings at both sides of a member constituting said sealing partition wall in a longitudinal direction of said motor rotor so that said housings directly receive a load applied to said bearings,

wherein said displacement measuring means comprises a resolver rotor made of a mass of magnetic metal material, disposed at a side of said motor rotor, and includes a salient tooth cut from said mass of magnetic metal material; and a resolver stator including a detection coil magnetic pole and disposed at a side of said motor stator.

2. A sealed actuator as claimed in claim **1**, wherein said resolver rotor is fixed to a member of a nonmagnetic substance.

3. A sealed actuator as claimed in claim **1**, wherein said resolver stator includes a differential circuit type winding.

4. A sealed actuator as claimed in claim **1**, further comprising a magnetic shield plate made of a magnetic metal material disposed between said stator magnetic pole of said motor stator and said detection coil magnetic pole of said resolver stator.

5. A sealed actuator as claimed in claim **1**, wherein said resolver rotor is fixed to a member of a nonmagnetic substance; wherein said resolver rotor includes a differential circuit type winding; and wherein said actuator further comprises a magnetic shield plate made of a magnetic metal material disposed between said stator magnetic pole of said motor stator and said detection coil magnetic pole of said resolver stator.

6. A sealed actuator comprising:

a motor stator including a stator magnetic pole excited by a rotation-drive coil;

a housing to which said motor stator is attached;

a motor rotor including a rotor magnetic pole disposed opposite to a surface of said stator magnetic pole through a gap;

bearings for rotatably supporting a rotation shaft of said motor rotor to said housing;

displacement measuring means for measuring displacement of said motor rotor; and

a hermetically sealing partition wall made of a nonmagnetic metal material and disposed at the gap between said stator magnetic pole and said rotor magnetic pole, a space where said motor rotor is disposed being hermetically isolated from a space wherein said motor stator is disposed;

wherein said displacement measuring means comprises a resolver rotor made of a mass of magnetic metal material, disposed at a side of said motor rotor, and includes a salient tooth cut from said mass of magnetic metal material; and a resolver stator including a detection coil magnetic pole and disposed at a side of said motor stator.

7. A sealed actuator as claimed in claim **6**, wherein said resolver rotor is fixed to a member of a nonmagnetic substance.

8. A sealed actuator as claimed in claim **6**, wherein said resolver stator includes a differential circuit type winding.

9. A sealed actuator as claimed in claim **6**, wherein said displacement measuring means includes a coarse resolver and a fine resolver configured such that it is unnecessary to return to an origin to detect the position of the motor rotor.

10. A sealed actuator as claimed in claim **6**, wherein said motor stator and said motor rotor constitutes a variable-reluctance motor.

11. A sealed actuator as claimed in claim **6**, further comprising a magnetic shield plate made of a magnetic metal material disposed between said stator magnetic pole of said motor stator and said detection coil magnetic pole of said resolver stator.

12. A sealed actuator as claimed in claim **6**, wherein said resolver rotor is fixed to a member of a nonmagnetic substance; wherein said resolver rotor includes a differential circuit type winding; and wherein said actuator further comprises a magnetic shield plate made of a magnetic metal material disposed between said stator magnetic pole of said motor stator and said detection coil magnetic pole of said resolver stator.

13. A sealed actuator comprising:

a motor stator including a stator magnetic pole excited by a rotation-drive coil;

a housing to which said motor stator is attached;

a motor rotor including a rotor magnetic pole disposed opposite to a surface of said stator magnetic pole through a gap;

bearings for rotatably supporting a rotation shaft of said motor rotor to said housing;

displacement measuring means for measuring displacement of said motor rotor; and

a hermetically sealing partition wall made of a nonmagnetic metal material and disposed at the gap between said stator magnetic pole and said rotor magnetic pole, a space where said motor rotor is disposed being hermetically isolated from a space where said motor stator is disposed;

wherein said sealed actuator further comprises reinforcing means for reinforcing at least a part of said hermetically sealing partition wall, said reinforcing means being made of substantially the same nonmagnetic metal material as said partition wall.

14. A sealed actuator as claimed in claim **13**, wherein said reinforcing means is at least one selected from a group consisting of a reinforcing member and a molding agent.

15. A sealed actuator comprising a plurality of unit sealed actuators connected in series to each other, each of said unit sealed actuators comprising:

a motor stator including a stator magnetic pole excited by a rotation-drive coil;

a housing to which said motor stator is attached;

a motor rotor including a rotor magnetic pole disposed opposite to a surface of said stator magnetic pole through a gap;

bearings for rotatably supporting a rotation shaft of said motor rotor to said housing;

displacement measuring means for measuring displacement of said motor rotor; and

a hermetically sealing partition wall made of a nonmagnetic metal material and disposed at the gap between said stator magnetic pole and said rotor magnetic pole, a space where said motor rotor is disposed being hermetically isolated from a space where said motor stator is disposed;

wherein said bearings are a plurality of rolling bearings, said rolling bearings supporting said motor rotor at positions on said housings at both sides of a member constituting said sealing partition wall in a longitudinal direction of said motor rotor so that said housings directly receive a load applied to said bearings;

wherein said rotor magnetic pole includes a salient pole tooth of a steel material of a magnetic substance subjected to salient pole working; and

wherein said displacement measuring means comprises a resolver rotor made of a magnetic metal material, disposed at a side of said motor rotor, and include a salient pole tooth; and a resolver stator including a detection coil magnetic pole and disposed at a side of said motor stator.

16. A sealed actuator comprising a plurality of unit sealed actuators connected in series to each other, each of said unit sealed actuators comprising:

a motor stator including a stator magnetic pole excited by a rotation-drive coil;

housings to which said motor stator is attached;

a motor rotor including a rotor magnetic pole disposed opposite to a surface of said stator magnetic pole through a gap;

bearings for rotatably supporting a rotation shaft of said motor rotor to said housing;

displacement measuring means for measuring displacement of said motor rotor; and

a hermetically sealing partition wall made of a nonmagnetic metal material and disposed at the gap between said stator magnetic pole and said rotor magnetic pole, a space where said motor rotor is disposed being hermetically isolated from a space where said motor stator is disposed;

wherein said bearings are a plurality of rolling bearings, said rolling bearings supporting said motor rotor at positions on said housings at both sides of a member constituting said sealing partition wall in a longitudinal direction of said motor rotor so that said housings directly receive a load applied to said bearings.

17. A sealed actuator comprising a plurality of unit sealed actuators connected in series to each other, each of said unit sealed actuators comprising:

a motor stator including a stator magnetic pole excited by a rotation-drive coil;

a housing to which said motor stator is attached;

a motor rotor including a rotor magnetic pole disposed opposite to a surface of said stator magnetic pole through a gap;

bearings for rotatably supporting a rotation shaft of said motor rotor to said housing;

displacement measuring means for measuring displacement of said motor rotor; and

a hermetically sealing partition wall made of a nonmagnetic metal material and disposed at the gap between said stator magnetic pole and said rotor magnetic pole, a space where said motor rotor is disposed being hermetically isolated from a space where said motor stator is disposed;

wherein said displacement measuring means comprises a resolver rotor made of a magnetic metal material, disposed at a side of said motor rotor, and including a salient tooth; and a resolver stator including a detection coil magnetic pole and disposed at a side of said motor stator.

18. A sealed actuator as claimed in claim **17**, wherein said resolver rotor is fixed to a member of a nonmagnetic substance.

19. A sealed actuator as claimed in claim **17**, wherein said resolver stator includes a differential circuit type winding.

20. A sealed actuator as claimed in claim **17**, wherein said displacement measuring means includes a coarse resolver and a fine resolver.

21. A sealed actuator as claimed in claim **17**, wherein said motor stator and said motor rotor constitutes a variable-reluctance motor.

22. A sealed actuator as claimed in claim **17**, further comprising a magnetic shield plate made of a magnetic metal material disposed between said stator magnetic pole of said motor stator and said detection coil magnetic pole of said resolver stator.

23. A sealed actuator as claimed in claim **17**, wherein said resolver rotor is fixed to a member of a nonmagnetic substance; wherein said resolver rotor includes a differential circuit type winding; and wherein said actuator further comprises a magnetic shield plate made of a magnetic metal material disposed between said stator magnetic pole of said motor stator and said detection coil magnetic pole of said resolver stator.

24. A sealed actuator as claimed in one of claims **15** to **22**, wherein said rotation shaft of said motor rotor is an extension shaft fixed to said motor rotor.

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